

**What Is Claimed Is:**

- 1           1.       A method for quantifying a number of identical consecutive digits  
2 starting from a fixed position within a string of  $n$  digits, comprising:  
3           converting the string of  $n$  digits into a thermometer code, wherein the  
4 thermometer code uses  $m$  bits to represent a string of  $m$  identical consecutive  
5 digits within the string of  $n$  digits;  
6           converting the thermometer code into a one-hot code in which only one bit  
7 has a logical one value; and  
8           converting the one-hot code into a logarithmic code representing the  
9 number of identical consecutive digits.
- 1           2.       The method of claim 1, wherein converting the string of digits into  
2 the thermometer code involves passing the string of digits through  $\lceil \log_2 n \rceil$  layers  
3 of AND gates, wherein a first layer of AND gates produces thermometer codes for  
4 sub-strings of length two, and wherein each consecutive layer produces  
5 thermometer codes for sub-strings of length  $k+1$  to  $2k$  by ANDing together  
6 thermometer codes for sub-strings of length 1 to  $k$  from preceding layers.
- 1           3.       The method of claim 1,  
2 wherein converting the thermometer code into the one-hot code involves  
3 passing the thermometer code through a single layer of two-input comparator  
4 gates;  
5 wherein a given comparator gate produces a logical one value when a first  
6 input of the comparator gate receives a logical one value and a second input  
7 receives a logical zero value; and

8 wherein a comparator gate is coupled between each consecutive pair of  
9 thermometer code bits, so that only one comparator gate, covering a boundary  
10 between consecutive logical ones and consecutive logical zeros, produces a  
11 logical one value.

1 4. The method of claim 1, wherein converting the one-hot code into  
2 the logarithmic code involves passing the one-hot code through  $\lceil \log_2 n \rceil - 1$  layers  
3 of OR gates, wherein a given bit in the logarithmic code is produced by ORing  
4 together bits of the one-hot code that cause the given bit in the logarithmic code to  
5 be asserted.

1 5. The method of claim 1, wherein the string of  $n$  digits is a string of  
2  $n$  binary digits.

1 6. The method of claim 1, wherein the fixed position in the string of  $n$   
2 digits is the beginning of the string, so that the number of leading identical  
3 consecutive digits is quantified.

1 7. The method of claim 6, wherein the number of leading zero values  
2 is quantified.

1 8. The method of claim 7, further comprising using the logarithmic  
2 code to normalize a result of a floating-point arithmetic operation.

1 9. The method of claim 1, further comprising using the logarithmic  
2 code to encode or decode a stream of data, wherein the logarithmic code  
3 represents a run-length of identical consecutive digits within the stream of data.

1           10.    The method of claim 1, wherein each digit in the string of  $n$  digits  
2 includes one or more binary digits.

1           11.    An apparatus that quantifies a number of identical consecutive  
2 digits starting from a fixed position within a string of  $n$  digits, comprising:  
3           a thermometer code circuit that converts the string of  $n$  digits into a  
4 thermometer code, wherein the thermometer code uses  $m$  bits to represent a string  
5 of  $m$  identical consecutive digits within the string of  $n$  digits;  
6           a one-hot code circuit that converts the thermometer code into a one-hot  
7 code in which only one bit has a logical one value; and  
8           a logarithmic code circuit that converts the one-hot code into a logarithmic  
9 code representing the number of identical consecutive digits.

1           12.    The apparatus of claim 11, wherein the thermometer code circuit  
2 includes  $\lceil \log_2 n \rceil$  layers of AND gates, wherein a first layer of AND gates produces  
3 thermometer codes for sub-strings of length two, and wherein each consecutive  
4 layer produces thermometer codes for sub-strings of length  $k+1$  to  $2k$  by ANDing  
5 together thermometer codes for sub-strings of length 1 to  $k$  from preceding layers.

1           13.    The apparatus of claim 11,  
2           wherein the one-hot-code circuit includes a single layer of two-input  
3 comparator gates;  
4           wherein a given comparator gate produces a logical one value when a first  
5 input of the comparator gate receives a logical one value and a second input  
6 receives a logical zero value; and

7 wherein a comparator gate is coupled between each consecutive pair of  
8 thermometer code bits, so that only one comparator gate, covering a boundary  
9 between consecutive logical ones and consecutive logical zeros, produces a  
10 logical one value.

1 14. The apparatus of claim 11, wherein the logarithmic code circuit  
2 includes  $\lceil \log_2 n \rceil - 1$  layers of OR gates, wherein a given bit in the logarithmic code  
3 is produced by ORing together bits of the one-hot code that cause the given bit in  
4 the logarithmic code to be asserted.

1 15. The apparatus of claim 11, wherein the string of  $n$  digits is a string  
2 of  $n$  binary digits.

1 16. The apparatus of claim 11, wherein the fixed position in the string  
2 of  $n$  digits is the beginning of the string, so that the number of leading identical  
3 consecutive digits is quantified.

1 17. The apparatus of claim 16, wherein the apparatus quantifies the  
2 number of leading zero values.

1 18. The apparatus of claim 17, further comprising a floating-point  
2 arithmetic unit that is configured to use the logarithmic code to normalize a result  
3 of a floating-point arithmetic operation.

1 19. The apparatus of claim 11, further comprising an encoder that is  
2 configured to use the logarithmic code to encode or decode a stream of data,

1 wherein the logarithmic code represents a run-length of identical consecutive  
2 digits within the stream of data.

1 20. The apparatus of claim 11, wherein each digit in the string of  $n$   
2 digits includes one or more binary digits.

1 21. A computer system including a circuit that quantifies a number of  
2 identical consecutive digits, comprising:

3 a processor;

4 a memory;

5 a quantifying circuit that quantifies the number of identical consecutive  
6 digits starting from a fixed position within a string of  $n$  digits, wherein the  
7 quantifying circuit includes,

8 a thermometer code circuit that converts the string of  $n$   
9 digits into a thermometer code, wherein the thermometer code uses  
10  $m$  bits to represent a string of  $m$  identical consecutive digits within  
11 the string of  $n$  digits;

12 a one-hot code circuit that converts the thermometer code  
13 into a one-hot code in which only one bit has a logical one value,  
14 and

15 a logarithmic code circuit that converts the one-hot code  
16 into a logarithmic code representing the number of identical  
17 consecutive digits.

1 22. The computer system of claim 21, further comprising:  
2 a floating-point arithmetic unit of within the processor;

3 wherein the quantifying circuit is located within the floating-point  
4 arithmetic unit and is configured to normalize results of floating-point operations.

1 23. The computer system of claim 21,  
2 wherein the computer system includes an encoding circuit for encoding or  
3 decoding streams of data; and  
4 wherein the quantifying circuit is located within the encoding circuit and is  
5 configured to quantify run-lengths of identical consecutive digits for the encoding  
6 circuit.